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PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant: Andrew Sharpe

Serial No.: 10/612,524

Filed: July 3, 2003

For: FLOW CONNECTOR

Group Art Unit: To be assigned

Examiner: To be assigned

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August 8, 2003

James P. Zeller
Reg. No. 28,491

SUBMISSION OF PRIORITY DOCUMENT

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Sir:

Submitted herewith are certified copies of Great Britain 0215431.8 filed July 4, 2002, and Great Britain 0304353.6 filed February 26, 2003, the priority of which are claimed under 35 U.S.C. § 119.

Respectfully submitted,

MARSHALL, GERSTEIN & BORUN LLP

By: _____
James P. Zeller
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August 8, 2003

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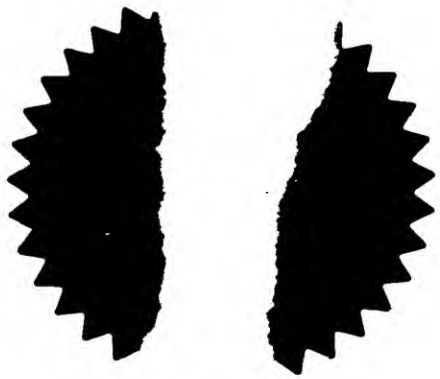

Signed Steph Wadley.

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Request for grant of a patent

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- 4 JUL 2002

1. Your Reference — P.6949.GBA

2. Patent application number *(The Patent Office will fill in this part)* — 0215431.8

3. Full name, address and postcode of the or of each applicant *(underline all surnames)*

Cirocco Ltd
Suites 4 and 5
Neath Farm Business Park
154 Church End
Cherry Hinton
Cambridge CB1 3LD

8333437001

Patents ADP number *(if you know it)*

If the applicant is a corporate body, give the country/state of its incorporation — G.B.

4. Title of the invention — FLOW CONNECTOR

5. Name of your agent *(if you have one)*

"Address for service" in the United Kingdom to which all correspondence should be sent *(including the postcode)*

MAGUIRE BOSS
5 Crown Street
St. Ives
Cambridgeshire
PE27 5EB

Patents ADP number *(if you know it)* — 07188725001

6. If you are declaring priority from one or more earlier patent applications, give the country and the date of filing of the or of each of these earlier applications and *(if you know it)* the or each application number

Country	Priority application number *(if you know it)*	Date of filing *(day/month/year)*

7. If this application is divided or otherwise derived from an earlier UK application, give the number and the filing date of the earlier application

Number of earlier application	Date of filing *(day/month/year)*

8. Is a statement of inventorship and of right to grant of a patent required in support of this request? *(Answer 'Yes' if:*
a) any applicant named in part 3 is not an inventor, or
b) there is an inventor who is not named as an applicant, or
c) any named applicant is a corporate body.)
See note (d)

Yes

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Continuation sheets of this form	
Description	6 ✓
Claims(s)	3 ✓
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Priority documents	
Translations of priority documents	
Statement of inventorship and right to grant of a patent *(Patents Form 7/77)*	
Request for preliminary examination and search *(Patents Form 9/77)*	1
Request for substantive examination *(Patents Form 10/77)*	
Any other documents *(please specify)*	

11. I/We request the grant of a patent on the basis of this application.

Signature MaguireBoss Date 04/07/2002

MAGUIRE BOSS

12. Name and daytime telephone number of person to contact in the United Kingdom IAN HARTWELL Tel: 01480 301588

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DUPLICATE

TITLE: FLOW CONNECTOR

DESCRIPTION

The present invention relates to flow connectors comprising male and female components that interlock in an axial direction thereof, particularly flow connectors of the 'dry disconnect' variety in which leakage of fluid on disconnection of the two connector components is reduced to negligible proportions or avoided completely.

Connectors of this kind are known from the tanker industry where they are used to connect flexible hoses. Rotation of a handwheel screws male and female components together in an axial direction and thereafter releases sealing valve members in both male and female components. Fluid passes around the circumference of these sealing valve members on its way from an axial inlet to an axial outlet. As will be appreciated, the resistance to flow of such an arrangement can be significant, giving rise to considerable pressure losses and increasing the necessary pumping power. The present invention has as an objective a fluid connector in which such losses are reduced.

Accordingly, the present invention consists in one aspect in a flow connector comprising male and female components that interlock in an axial direction thereof; said male and female components having a flow inlet, a flow outlet and a sealing valve member moveable in said axial direction to control flow between said flow inlet and outlet; wherein at least one flow inlet or flow outlet is defined by a passageway, flow through said passageway being predominantly in a direction other than said axial direction, thereby reducing the resistance to flow presented by said sealing valve member.

Inlet or outlet flow predominantly in a direction other than said axial direction, per the present invention, reduces the degree of flow around the circumference of sealing valve members, thereby reducing pressure losses. Advantageously, the flow through the passageway is predominantly in a direction normal to the axial direction. The invention also consists in male and female connector components of a flow connector. Yet further advantageous embodiments of the invention are set out in the description and claims.

The invention will now be described by way of example by reference to the following diagrams, of which:

Figures 1A and B are sectional views taken along the longitudinal axes of male and female components of a flow connector according to the present invention;

Figure 2 illustrates the male and female components when interlocked

Figures 3A and B are detail views of the sealing valve member assembly of figures 1 and 2;

Figures 4 is a perspective view of an electronics fluid cooling system incorporating a flow connector according to the present invention;

Figures 5A and B are front and side diagrammatic views of a manifold assembly for the system of figure 4.

Figure 1A shows the male component 1 of the connector and comprising a main body 5 housing a central sealing valve member assembly 30. Main body 5 comprises a first tubular section 28 for insertion into the female component and which is contiguous to (and preferably integral with) a wider tubular section 29. Slideably mounted within each of these two tubular sections is assembly 30, made up of a sealing valve member (O-ring 11) mounted in a groove 20 formed in a

plunger 21. This in turn is connected by means of flat plate member 22 to tubular member 23 which is formed with a conduit 24 itself connected to an axial flow port 26. By means e.g. of a flexible pipe 25 connected to assembly 30 by means of hose barb, fluid is supplied through the axial flow port 26 into a chamber 27 defined by main body 5 and assembly 30. Chamber is sealed at one end by O-ring 11 bearing against the wall of the bore of tubular section 28 and at the other end by a second O-ring 12 bearing against the wall of the bore of wider tubular section 29.

The female component of the connector is illustrated in figure 1B and comprises a housing 2 having a first bore 31 having a mouth 35 for reception of the male member 30 and, contiguous therewith, a second bore 32 in which is slidably mounted a plunger 3 sealed against the wall of bore 32 by an O ring 13. To allow flow to/from the connector, bore 32 is formed with ports 33 in a direction other than said axial direction 34, in this case normal to the axial direction. Spring 35 biases plunger 3 to a position in which flow between the holes 33 and bore 31 is prevented by the further sealing valve member, O ring 13.

Operation of the connector is illustrated in figure 2. Firstly, the main body 5 of the male component 1 is interlocked in an axial direction with the bore 31 of the female component, a fluid seal between the two components being effected by O-ring 14 bearing against the wall of bore 31. Secondly, collet 4 is moved against spring 41, initially forcing latch 42 (by means of cam surface 44) to engage with a flange 43 on the female part.

Once male and female components are securely latched together, further movement engages collet 4 with shoulder 40 of the sealing valve member assembly 30, sliding the latter inside main body 5 from the first position shown in figure 1A to the second position shown in figure 2. In this position, the plunger 21 is moved out of the male tubular member 28, allowing flow out of the male component as indicated by arrows B, and sufficiently far into the bore of the female component to allow this flow to pass through ports 33. It will also be noted that in moving to its

second position, plunger 21 engages with the corresponding plunger 3 of the female member, forcing this to move back along bore 32 and reveal ports 33.

Figure 3 details by means of arrows the flow through the sealing valve member assembly 30. Advantageously, plunger 21 is tapered in the axial direction, having a conical form as shown at 50, thereby to reduce the resistance to the transition of flow from axial as shown at 51 to perpendicular as shown at 52. Flow may also be facilitated by generally flat plate member 22 which, as shown in the detail of figure 3B, is connected to the remainder of assembly 30 across the mouth of conduit 24, thereby improving structural rigidity and alignment.

Disconnection is achieved by pushing the latch members 42 inwards so as to release catch 46, spring 44 then pulling sealing valve member assembly 30 backwards into engagement with the bore of tubular member 28, thereby preventing flow. Spring 35 similarly prevents fluid flow through female component 2. Thereafter, the latch is fully released and the connector bodies can be disengaged.

The construction of plungers 3,21 with flat end faces 7, 15 that engage over substantially all their area and O-rings 11,13 positioned adjacent (preferably as close as possible) to those end faces ensures that there are substantially no cavities in which fluid can be retained when respective assemblies are engaged, thereby reducing fluid leakage after the male and female components are disconnected to negligible proportions (just a wetted surface).

Although not restricted in its application, the present invention is particularly suited to arrangements in which the female connector member is mounted on a duct, pipe, manifold, rectangular section pipe 6, tank wall, or other surface. Such an arrangement is shown in figures 1 and 2, the female connector 2 being secured to the wall 6 of a duct by securing means such as a screw thread 34 engaging with a corresponding thread in the wall. Spanner flats may be formed on adjacent collar 45 to facilitate the screwing / tapping process. Preferably, the securing means are configured and the elements of the female member sized so as to facilitate

installation of the female member from one side only of the wall, a measure particularly important wherever there is no means of access to the other side of the wall.

A particularly preferred application is in ducts where there is flow transverse to the axis of the connector (as indicated by arrows 16 in figure 2). To minimise the resistance to flow in the duct presented by the female member, that part of the female member protruding into the duct is made as slim as possible. This results in an overall shape of the female member that tapers in an axial direction away from its mouth 35.

Such a preferred implementation is known from co-pending UK patent application number 0204583 (incorporated herein by reference). Referring to figure 4, this application discloses an electronics fluid cooling system 69 according to the present invention when incorporated into a conventional server rack 61. Mounted in the rack are electronic apparatus 62 (e.g. server, computer, storage device) each of which has a local cooling circuit discussed in more detail below.

Each local cooling circuit is connected by means of pipes 63 to a 'global' cooling circuit 4 comprising a manifold assembly 65 arranged vertically within the side or back panel of the rack and an external radiator / heat exchanger 68. Hot fluid from the local cooling circuits is fed to the heat exchanger 68 and heat transferred to a heat sink (typically the atmosphere, alternatively a chilled water supply) by means of pipes 66. Cooled fluid then returns to a control unit 67 located at the base of the rack and housing a pump for feeding fluid between back to the manifold assembly 65.

As will be evident from the front and side schematic views of figures 5A and 5B, manifold assembly 65 comprises two individual manifolds or aisles 70, 71. Cold aisle 60 is fed with cold fluid (fluid at a lower temperature than the components it is cooling) from control unit 67 via a pipe 72. The cold aisle 72 is in turn connected in parallel via pipes 73 to each electronic equipment 62 and cold fluid is distributed

between them. After passing through each equipment 62, the fluid is then directed back to hot aisle 71 and thence (via pipe 74) to control unit 67. From here, the fluid is piped to the fluid inlet of an external radiator 68 to lower the temperature back to cold levels. The fluid then exits the radiator via a fluid outlet, returning to the control unit and passing around the system again. The connections allow electronic equipment to be connected to the manifold via pipes. An electronic equipment is connected to both the cold aisle and the hot aisle. Advantageously, each manifold 70,71 is equipped at its top end with an air release device to remove unwanted air. Alternatively or in addition, the fluid circuit may be operated at a pressure below atmospheric. In the event that the circuit is punctured, this ensures that air is sucked into the circuit rather than fluid leaking out. The release device allows such air to be bled from the circuit.

Flow connectors according to the present invention are shown at 75. Connecting the global fluid circuit 64 and particularly the manifold aisles 70,71 to fluid circuits in respective electronic equipment 62, they provide repeatably-connectable, self-sealing connections which allow individual electronic apparatus to be removed from the rack and other apparatus to be installed in its place. Furthermore, the self-sealing nature of the connection allows this to be achieved without the risk of fluid leakage that would otherwise necessitate a shut down of the entire cooling system whenever an electronic unit was to be replaced. Advantageously, a touch sensor may be embedded in the tip of the plunger of the flow connector, indicating when a connection is made or broken. This in turn will indicate to a control unit how may individual electronic apparatus, e.g. servers, are plugged into the fluid supply at any given time.

It should be understood that this invention has been described by way of examples only and that a wide variety of modifications can be made without departing from the scope of the invention as defined by the claims. In particular, the invention is not restricted to the predominantly radial flow directions shown in the example.

CLAIMS

1. Flow connector comprising male and female components that interlock in an axial direction thereof; said male and female components having a flow inlet, a flow outlet and a sealing valve member moveable in said axial direction to control flow between said flow inlet and outlet;

wherein at least one flow inlet or flow outlet is defined by a passageway, flow through said passageway being predominantly in a direction other than said axial direction, thereby reducing the resistance to flow presented by said sealing valve member.

2. Flow connector according to claim 1, wherein sealing valve member said male component comprises a tubular member insertable in a bore in said female member; said sealing valve member being moveable within a bore of said tubular member.

3. Flow connector according to claim 1 or 2, wherein said passageway is formed in said bore in said female member.

4. Flow connector according to claim 3, wherein said sealing valve member is moveable from a first position within said bore of said tubular member to a second position within said bore in said female member, thereby to allow flow through said passageway formed in said bore in said female member.

5. Flow connector according to claim 4, wherein said female member includes a further sealing valve member, moveable within said bore of said female member to control flow through said passageway formed in said bore in said female member.

6. Flow connector according to claim 5 when dependent on claim 4, wherein said sealing valve member and said further sealing valve member each form part of respective assemblies, the further sealing valve member assembly being engageable by the sealing valve member assembly, thereby to move said further sealing valve member assembly.

7. Flow connector according to any previous claim, wherein said sealing valve member assembly comprises a plunger supporting said sealing valve member, said plunger being tapered in the axial direction, thereby to reduce the resistance to flow through said passageway in a direction other than said axial direction.

8. Flow connector according to any previous claim, wherein said bore of said tubular member is connected to an axial flow port via a conduit formed in said sealing valve member assembly.

9. Flow connector according to claim 8, wherein said conduit is formed in a further tubular member slidably arranged in said tubular member, said further tubular member and said plunger being connected by a flat plate

10. Flow connector according any of claims 5 to 9, wherein there are substantially no cavities between said sealing valve member and said further sealing valve member when respective assemblies are engaged, thereby avoiding retention of flow after the engagement is broken.

11. Flow connector according to claim 10, wherein said sealing valve member and further sealing valve member assemblies each comprise a plunger having respectively engageable faces, said sealing valve member and further sealing valve member being located adjacent respective faces.

12. Flow connector according to claim 10 or 11, wherein said respectively engageable faces are flat and engage over substantially all their area, thereby avoiding retention of flow after engagement is broken.

13. Flow connector according to any previous claim, wherein said sealing valve member and/or said further sealing valve member is spring biased towards a position in which fluid flow is prevented.

14. Flow connector according to any previous claim, wherein the bore of said female member has a mouth for receiving said male member, and wherein the external profile of said female member tapers away in said axial direction from said region of said female member adjacent said mouth.

15. Flow connector according to any previous claim, wherein said female member includes means for attaching said female member to the wall of a fluid channel.

16. Flow connector according to any previous claim, wherein said means are operable from one side only of said wall of a fluid channel.

17. Flow connector according to claim 16, wherein said means for attaching said female member to the wall of a fluid channel is a screw thread engageable with a corresponding screw thread on said wall.

18. Connector according to any previous claim, wherein flow through said passageway is predominantly in a direction normal to said axial direction.

19. Male flow connector component of a flow connector according to any of claims 1 to 18.

20. Female flow connector component of a flow connector according to any of claims 1 to 18.

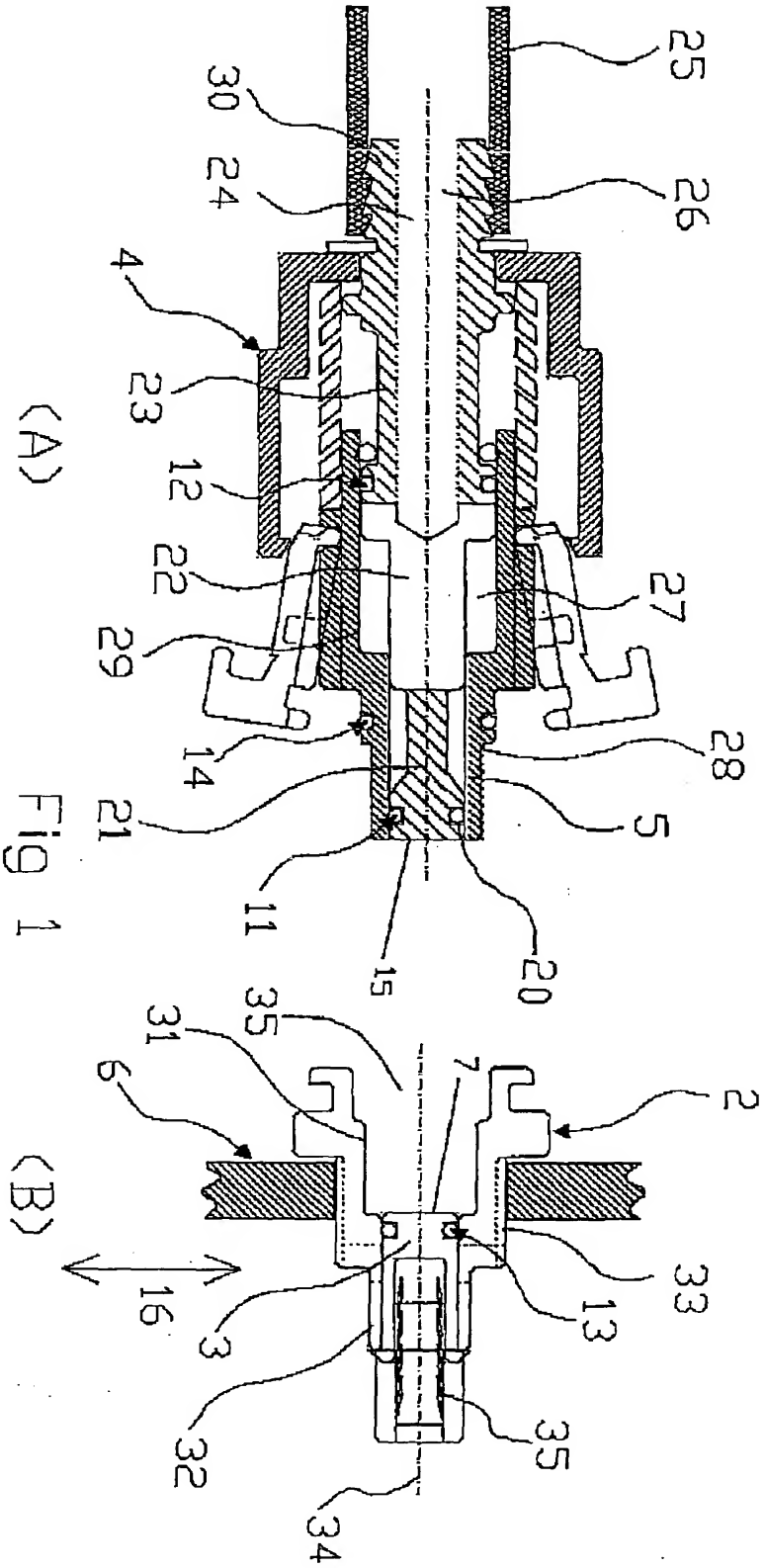
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Fig 1

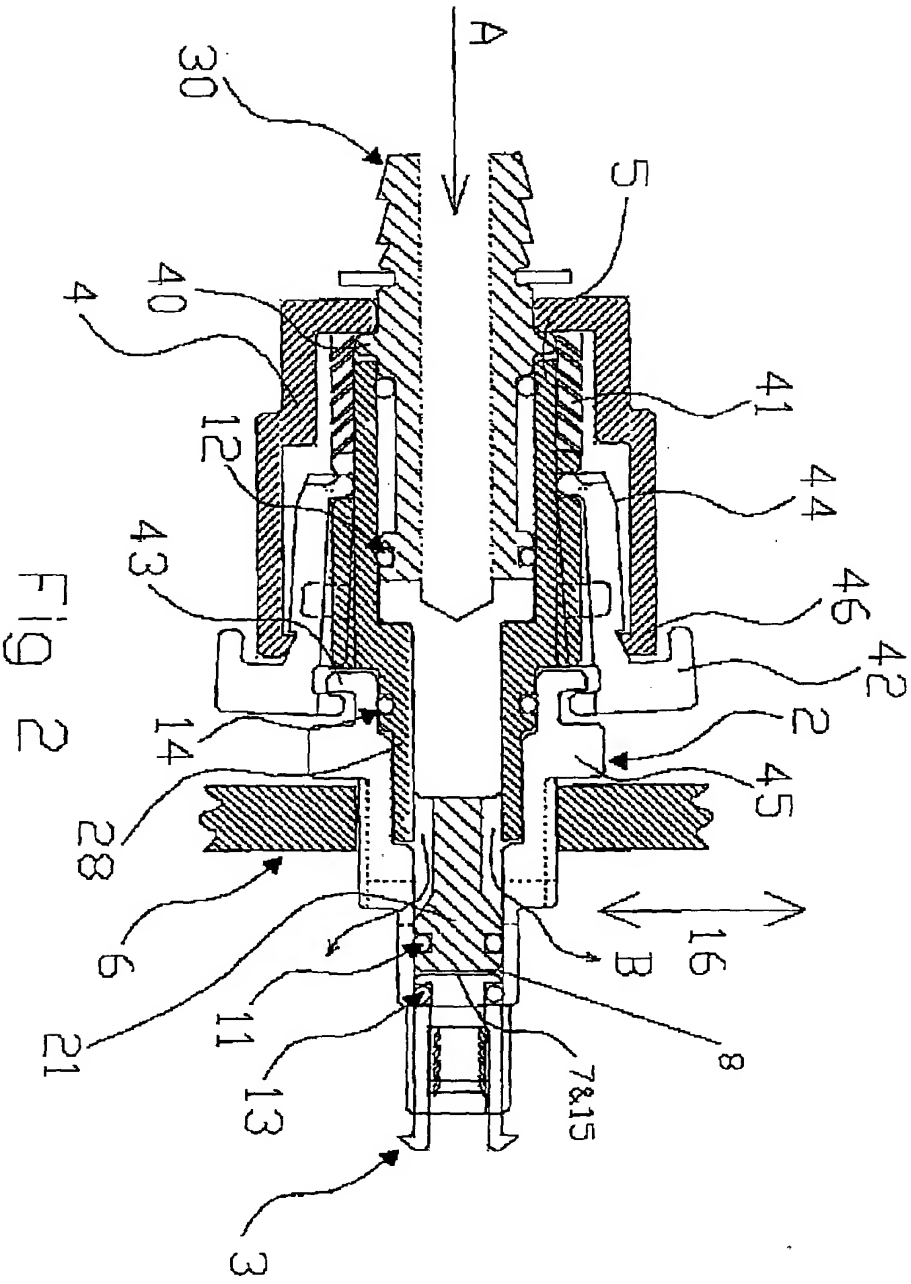

FIG 2

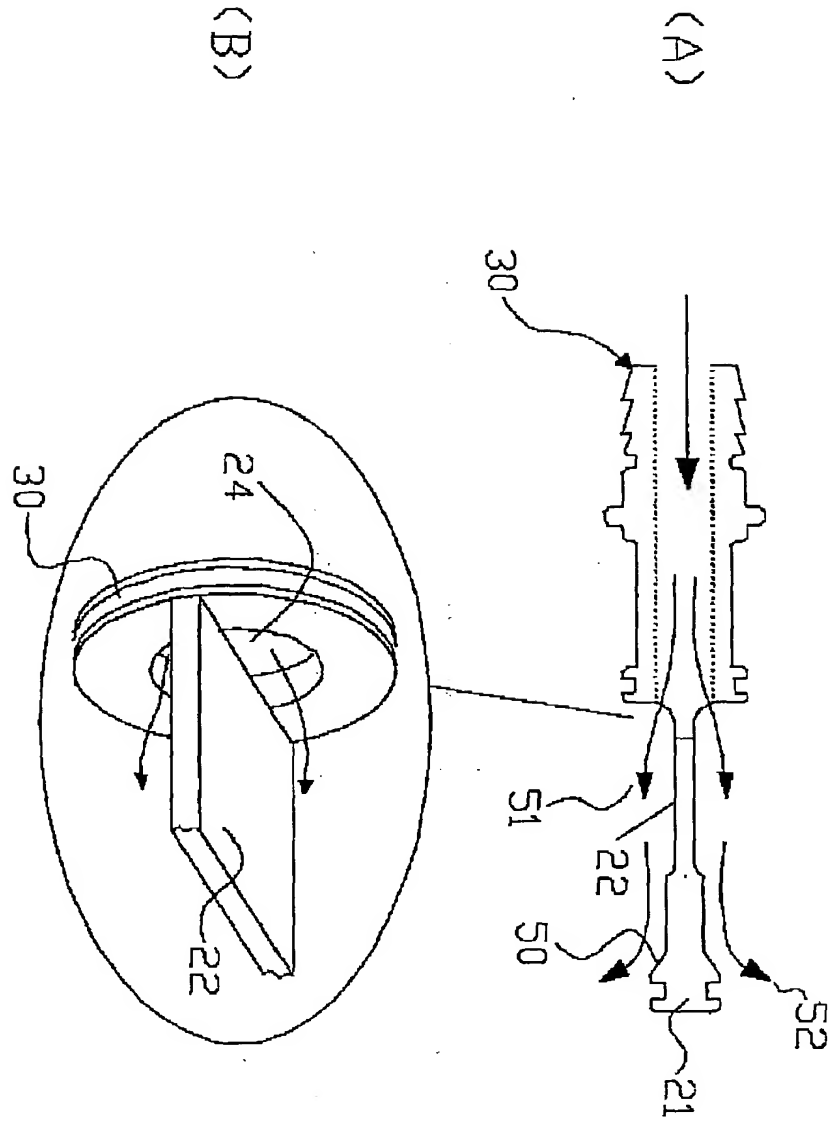

Fig 3

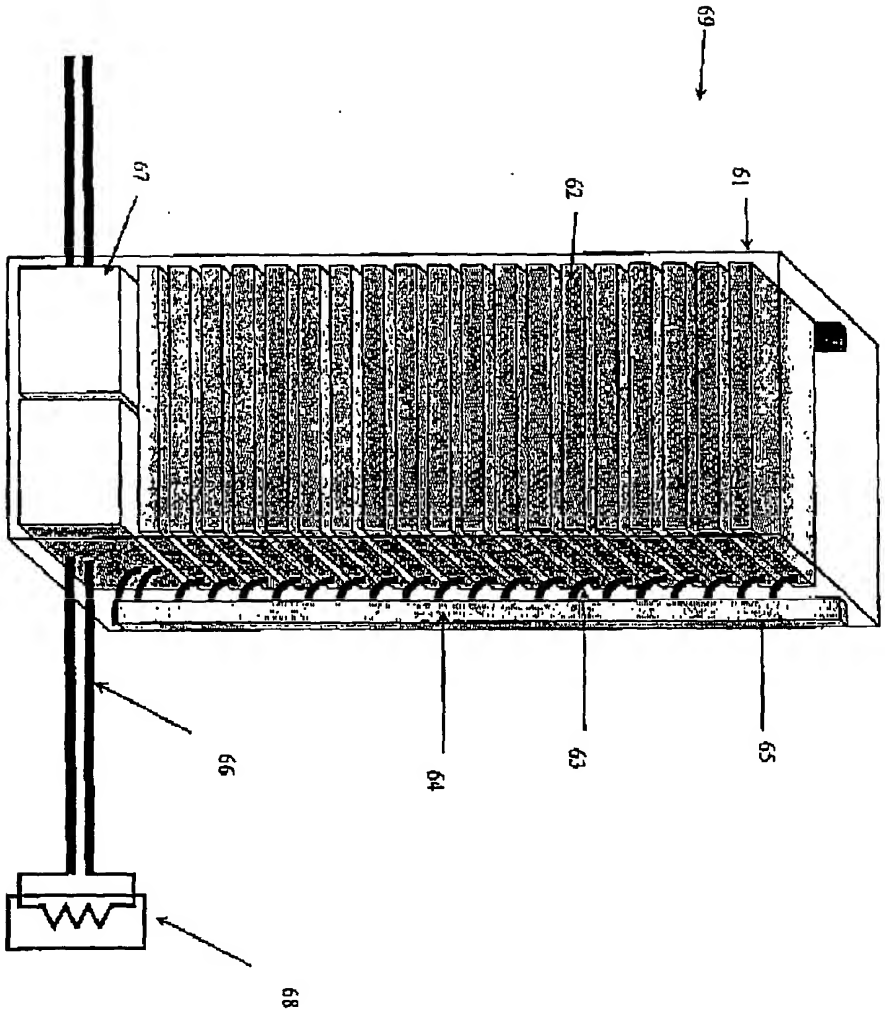

Fig4

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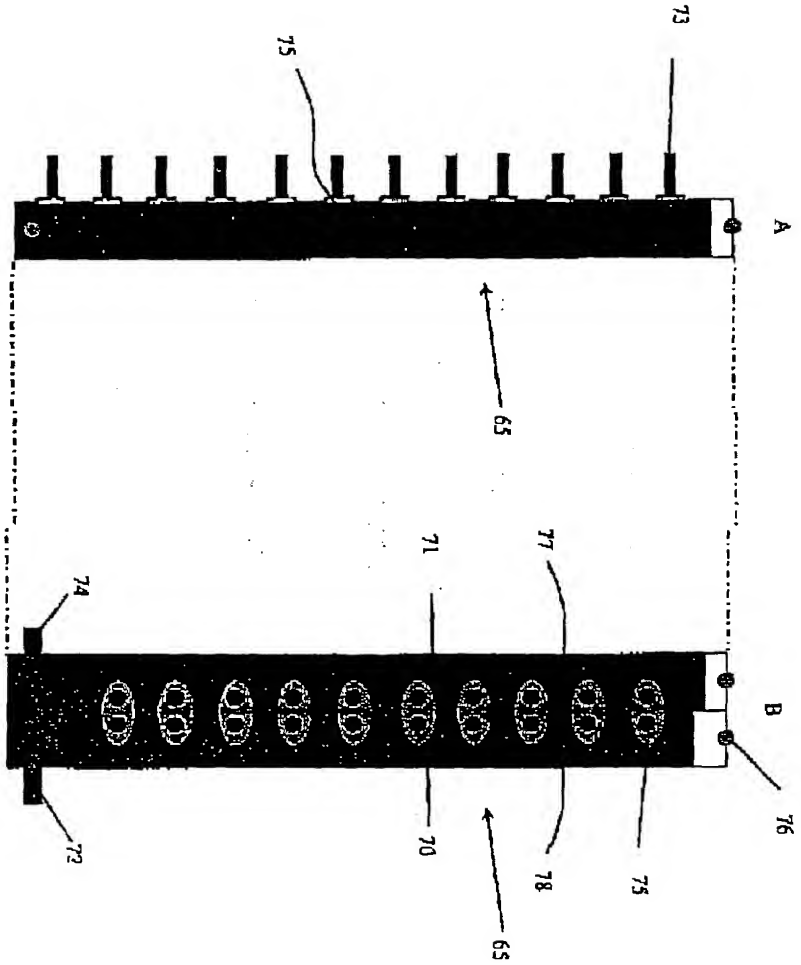

Fig 5